

**United States Naval Academy
Mechanical Engineering Department**

EM423 Mechanical Vibrations

Catalog Description: EM423 Mechanical Vibrations **Credit:** 3 (2-2-3)

The treatment of vibration fundamentals including free, damped and forced harmonic vibrations of linear single and multi-degree of freedom systems, modal analysis, continuous systems and a practical project.

Prerequisites: Strengths of Materials, Differential Equations, Dynamics

Textbooks: Inman, D.J., *Engineering Vibration*, 2nd edition, Prentice Hall, *optional*
Thomson, W.T. and Dahleh, M.D., *Theory of Vibration with Applications*, 5th edition, Prentice Hall, *optional*

Course Director: Assoc. Prof. C.P. Ratcliffe

Objectives¹:

1. To introduce students to a combination of traditional and state-of-the-art mechanical vibration theory and methods, and their application to real world engineering (a, b, c).

Course Content:

No.	Topic or Subtopic	hrs.
1	Introduction	1
2	Continuous systems	11
3	Single Degree of Freedom – unforced motion	4
4	Single Degree of Freedom – forced motion	6
5	Vibration absorber	3
6	Discrete systems – decoupling equations of motion	3
7	Discrete systems – modal analysis (theory and experiment)	4
8	Project	24

Evaluation:

- | | |
|------------------------------------|-----|
| 1. Quizzes | NO |
| 2. Homework | YES |
| 3. Exams | YES |
| 4. Laboratory Reports | YES |
| 5. Oral Presentations | YES |
| 6. Design Reports/Notebooks | NO |
| 7. Prototypes/Demonstrations | NO |
| 8. Projects | YES |
| 9. any other evaluation tools used | NO |

Acquired Abilities²:

EM423 Mechanical Vibrations

- 1.1 Students will demonstrate the ability to analyze the free motion of simple continuous systems (2, 3, 4)
- 1.2 Students will demonstrate the ability to analyze wave motion in strings, rods, shafts and beams (2, 3, 4)
- 1.3 Students will demonstrate the ability to analyze the free and forced response of a single degree of freedom mechanical oscillator, and apply the work to real world engineering examples (2, 3, 4)
- 1.4 Students will demonstrate the ability to analyze and design a tuned vibration absorber (2, 3)
- 1.5 Students will demonstrate the ability to analyze discrete mass/spring systems and determine natural frequencies and mode shapes, both analytically and experimentally (2, 3, 4, 5, 8)
- 1.6 Students will demonstrate the ability to work in groups (4, 8))
- 1.7 Students will demonstrate the ability to communicate effectively in both the written word and by oral presentation (3, 5, 8)

Date of Latest Revision: 13 SEP 2001

¹ Letters in parenthesis refer to the [Program Objectives](#) of the [Mechanical Engineering Program](#).

² Numbers in parenthesis refer to the evaluation methods used to assess student performance.